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RECENT EVOLUTION OF THE MESSOLONGI LAGOON (WESTERN GREECE)

ABSTRACT: DE PIPPO T. & STAMATOPOULOS L., *Recent evolution of Messolongi Lagoon (Western Greece).* (IT ISSN 0391-9838, 2000).

The evolution of the Messolongi lagoon and the Acheloos river during the Holocene are controlled by the sea level fluctuations and the Quaternary tectonics of the area. The Acheloos river was not able to cross the gorge located to the north of the depression of Etolikon, very probably aggraded, and was forced to build a new channel flowing west of the gorge. Therefore the river moved the mouth in correspondence of Nisos Tholi, westward to the previous, flowing on the deltaic plain of Messolongi. The course of the Acheloos has moved more and more westward to the actual mouth with a strong progradation of the plain and of the mouth incorporating some of the Echinades Islands, as observed by Thucidide.

At present all sandy barrier ridges of the lagoon of Messolongi have been eroded as the subsidence of the wider region was not compensated by the fluvial supply. The sandy bodies that encircle the Klisova Lagoon are still present because of the continuous supplying of the river Evinos.

KEY WORDS: Geomorphology, Lagoons, Gulf of Patras, Greece.

ΣΥΝΟΨΗ: DE PIPPO T. & STAMATOPOULOS L., *Πρόσφατη εξέλιξη της λιμνοθάλασσας του Μεσολογγίου (Δυτική Ελλάδα).* (IT ISSN 0391-9838, 2000).

Η εξέλιξη της λιμνοθάλασσας του Μεσολογγίου και του Αχελώου ποταμού κατά τη διάρκεια του Ολοκαίνου ελέγχεται από τις μεταβολές της στάθμης της θάλασσας και την τεκτονική της περιοχής κατά την διάρκεια του Τεταρτογενούς. Ο Αχελώος δεν μπόρεσε να τμήσει την κοιλάδα που εντοπίζεται βόρεια του βυθίσματος του Αιτωλικού, πιθανότατα διευρύνθηκε και υποχρεώθηκε στη δημιουργία ενός νέου καναλιού, δυτικά του φραγμού. Για τον λόγο αυτό το στόμιο του ποταμού τώρα εντοπίζεται απέναντι από τη νήσο Θολή, δυικά της προηγούμενης θέσης, επί της δελταϊκής πεδιάδας του Μεσολογγίου. Η ροή Αχελώου μετατοπιζόταν συνεχώς προς τα δυτικά, προς τη σημερινή θέση της εκβολής, με ταυτόχρονη προέλαση της πεδιάδας και με αποτέλεσμα την ενσωμάτωση μερικών από τις Εχινάδες νήσους σε υτήν, γεγονός που αναφέρεται και από τον Θουκυδ η. Σήμερα οι αμμώδεις ράχες της λιμνοθάλασσας του Μεσολογγίου έχουν διαβρωθεί λόγω της καθίζησης της ευρύτερης περιοχής χωρίς να έχουν αναπληρωθεί από την ποτάμια παροχή. Οι αμμώδεις φραγμοί που περικλείουν τη λιμνοθάλασσα της Κλείσοβας υπάρχουν ακόμη λόγω της συνεχούς παροχής του ποταμού Εύηνου.

ΛΕΞΕΙΣ ΚΛΕΙΔΙΑ: Γεωμορφολογία, Λιμνοθάλασσα, Πατραϊκός κόλπος, Ελλάδα.

INTRODUCTION

The Messolongi lagoon is located north of the Gulf of Patras and constitutes the ancient delta of the Acheloos river.

Acheloos is a 240 km long river in Western Greece. It springs at an altitude of 1670 m a.s.l. from the slope of Peristeri mountain at the western part of Pindos mountain range and flows mainly through flysch sediments (Liakouris, 1971). East of the Messolongi Lagoon there are the Klisova Lagoon limited by the deposits of the ancient delta of the Acheloos river and from the ancient and modern deposits of the delta of the Evinos river.

In the Early Holocene, the Acheloos river was discharging in the Ionian Sea, in front of the Echinades Islands (Piper & Panagos, 1981; Stamatopoulos & Brancaccio, 1997). Acheloos river presently drains along a coastal plain which is pierced by Pre-Neogene bedrock hills, in the western side of Patras Gulf.

The Gulf of Patras, a Quaternary graben, is characterized by a broad zones of intense seismicity (Ferentinos & *alii*, 1985; Doutsos & *alii*, 1987). The Gulf to the north is fringed northward by the Quaternary deltaic deposits of the Acheloos and Evinos rivers and to the south by marine and lagunal facies which are 1500 m in thickness.

According to Piper & Panagos (1981) the Acheloos river delta has a meandering river channel and prior to the flood regulation had an annual suspended load and bed load discharge of 3 to $4x10^6$ tons and $2x10^6$ tons x year, respectively.

EVOLUTION OF THE INVESTIGATED AREA BASED ON FORMER DATA

From the morphological point of view, the Gulf of Patras, during the Quaternary (Stage 7) was a lake; a morphological threshold high located, 250 Ka B.P., near the Zakynthos Channel prevented the entry of the waters of the Ionian Sea inside of the two gulfs (Piper & *alii*, 1990).

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After the channel tectonic opening, the Gulf has influenced by the effects of the glacio-eustatic variations. At the maximum lowering of the sea level (Stage 2) the Gulf of Patras was completely emerged, and the Acheloos river, was flowing in the Ionian Sea. During the postglacial slow rising of the sea-level, a deltaic progradation occurred, followed by wide coastal transgression due to the generalised stability of the sea level in the middle Holocene (Chronis & *alii*, 1991).

The stratigraphic sequence recognised in the area shows deposits due to deltaic progradation and/or estuaries formation in a basin strongly influenced by the sea level oscillations.

The modern Acheloos river mouth is located north of Nisos Oxia, but in the study area three ancient systems of meandering channels are present (Piper & Panagos, 1981). The traces, still clearly visible, of the most ancient river bed show a course of water flowing from Neohorion toward east reaching the depression of Etolikon and therefore the Lagoon of Messolongi (fig. 1). A following modification carries the river to flow toward Island; the most recent of the ancient river bed shows a river mouth in correspondence of Akra Scrofa, few kilometers from the present day position (fig. 1).

COASTAL VARIATION INFERRED BY MAPS COMPARISON

The analysis of the recent and present day evolution of the lagoon of Messolongi was carried out by the comparison between the map of the 1740 drawn from the Atlas of the Duke of Vurgundia and the topographic maps of 1864 and 1940 published from the K.K. Militar Geogr. Institut (Wien) and from the Hellenic Army Geographical Service, respectively.

The map of the 1740 could be used only from the general point of view, as in fact it has not been drawn on a geodetic base. The map show that the mouth of the Acheloos river was located northwest of the Messolongi Lagoon, in front of the Echinades Islands. Thucidide in the second century A.D. mentioned that the river was discharging in the same place (Stamatopoulos & Brancaccio, 1997).

A more precise comparison is possible to be done between the more recent maps. In the 1864 map the Lagoon of Messolongi appears, almost completely filled by the deposits of the Acheloos and Evinos rivers deltas. Between them the Klisova Lagoon is visible, separated by the sea by a thin sandy barrier ridge (fig. 2).

The same Lagoon of Messolongi is separated from the Etolikon depression by a thin channel that could represent an ancient trace of the bed of the Acheloos river when it flowed toward the lagoon (fig. 2). In the same map is possible to observe that sandy islands shape in the lagoon indicates that they are made by the river alluvial deposits. Great part of this sandy islands was dissected by the river during the immigration toward the east.

The map of the 1940 show a complete invasion of sea waters inside the lagoon; some remnants of the former the sandy islands of Nisos Tholi and Akra Scrofa are visible in relation of the ancient mouths of Acheloos river (figs. 1, 2b).

Many meanders northwest of the same inhabited centre of Messolongi are observed to confirm the former presence of the ancient channel of the Acheloos river inside the lagoon. The Lagoon of Klisova, to the contrary, present almost the same form observed in the map of the 1864. In fact it is separate from the Lagoon of Messolongi and from the waters of the Gulf of Patras by thin barrier sandy ridge. The western ridge is slightly moved respect at 1864. It is possible deduce it from the road that in the 1864 came loose on the sandy body while in the 1940 is builded on pylons inside the same lagoon (figs. 1, 2).

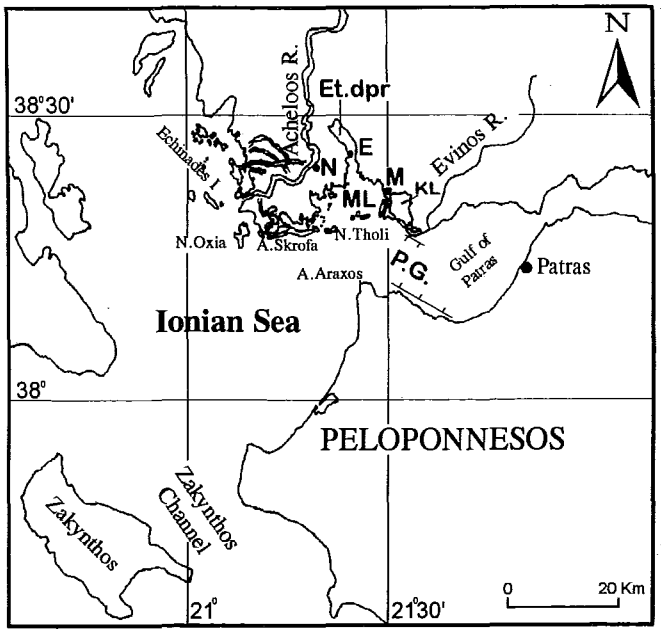

FIG. 1 - General map showing the Acheloos Delta and Messolongi lagoon. M = Mesolongi, E = Etolikon, Et. dpr = Etolikon depression, KL = Klisova lagoon, N = Neochorion, ML = Messolongi Lagoon, P.G. = Patras Graben.

CONCLUSIONS

The Holocene evolution of the Lagoon of Messolongi and the Acheloos river bed modifications are strongly linked to the Quaternary tectonics and to the eustatic oscillations of sea level that has affected the area of the Gulf of Patras.

Particularly during the stage 7 the Acheloos river flowed into the Gulf of Patras. During the opening of the Zakynthos Channel the gulf have been exposed to the effects of the glacio-eustatic variations of sea level. Therefore a fluvial erosion occurred during the low stand of sea levels and an alluvial aggradation during highstands (Piper & *alii*, 1990). At this time the aggradation compensate a 0.5 cm for year subsidence of the area (Brooks & Ferentinos, 1984).

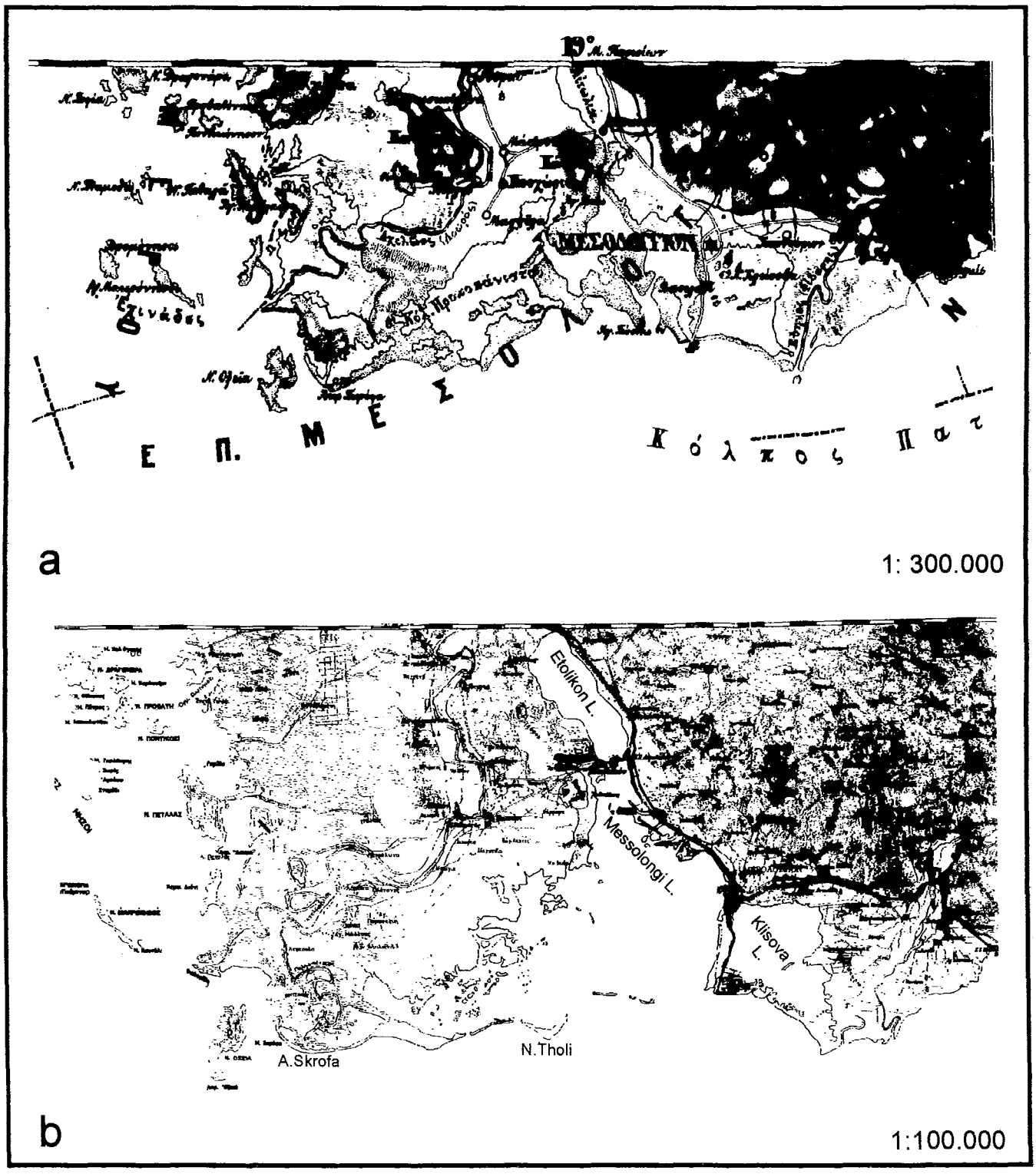

FIG. 2 - Topographics maps which showing the morphologic evolution between the years 1864 (1:300000) a and 1940 (1:100000) b respectively.

During the last glacial maximum (Stage 2) with a lowering of the sea level at about 120 m with respect to present day level, the Gulf of Patras has emerged completely and, on a plain with low gradient located in the Western part of the central graben, the Acheloos river flowed. The low depth of the Gulf of Patras northward of Akra Araxos is probably the result of the progradation of the Acheloos delta which was flowing in the Ionian Sea.

The stratigraphic sequences recognised in the area points out that, during the phases of fast rising of the sea, the valleys were invaded by waters resulting in the formation of estuaries.

After the phase of maximum low stand (13.000-10.500 years B.P.), the fast rising of the sea, around 5,000 years B.P., produced the consequent rising of the base level with aggradation of the alluvial plain and many stretches of the river. Consequently the Acheloos river was not able to cross the gorge located to the north of the depression of Etolikon, very probably aggraded, and was forced to build a new channel flowing westward of the gorge. Therefore the river moved the mouth in correspondence of Nisos Tholi, westward to the previous, flowing on the deltaic plain of Messolongi.

The sandy deposits of the present delta in correspondence of the Lagoon of Messolongi, is not any more supplied with the material transported by the river, have been eroded from the swell action and in the same time submerged due to the continuous subsidence of the area. The course of the Acheloos consequently has moved more and more westward to the actual mouth with a strong progradation of the plain and of the mouth incorporating some of the Echinades Islands, as observed by Thucidide.

Currently all sandy ridges of the lagoon of Messolongi have been eroded as the subsidence was not compensated by the fluvial supply. The sandy bodies that encircle the Klisova Lagoon are still present because of supplying of the river Evinos delta river.

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